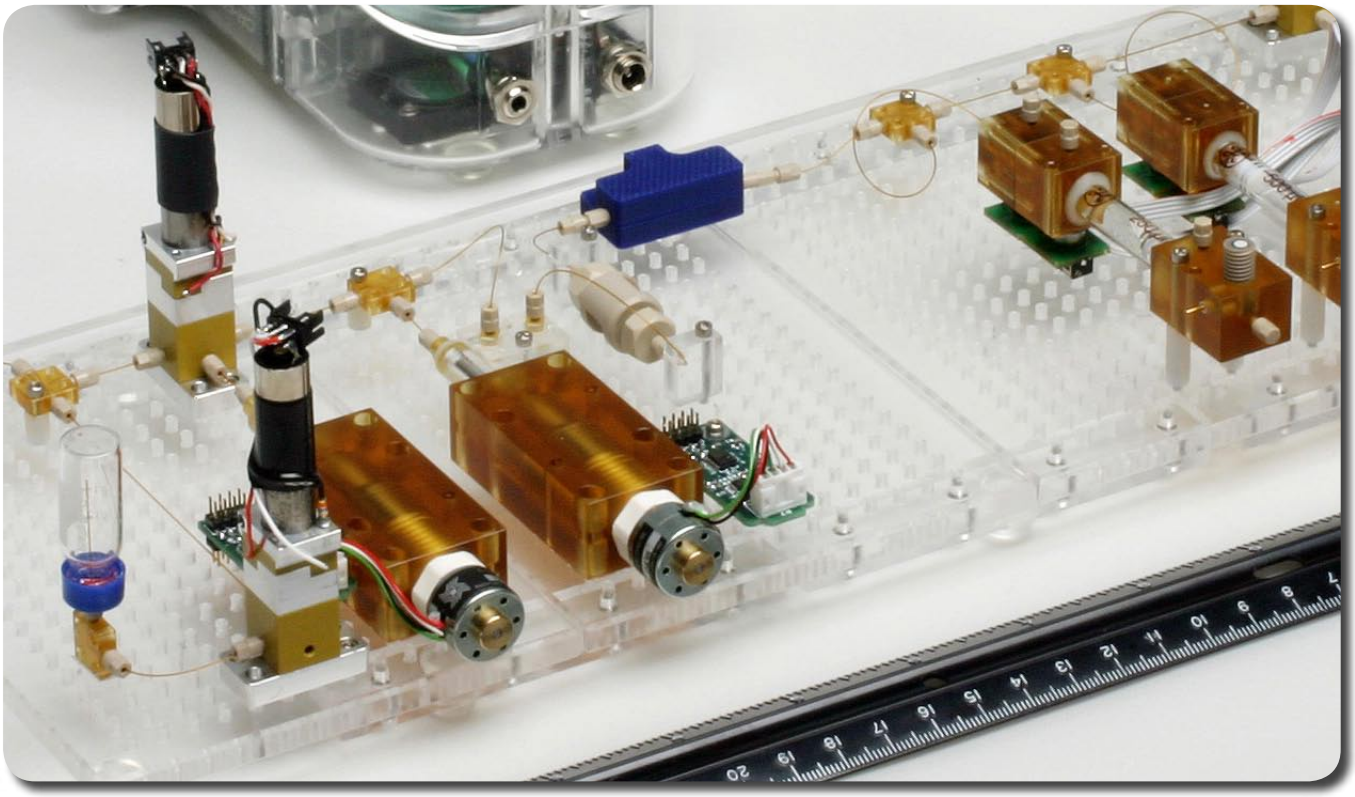
Sandia National Laboratories

MICROFLUIDIC CONNECTIONS

FITTINGS, INTERCONNECTS, MANIFOLDS, VALVES, PUMP & BREADBOARD DESIGNED FOR MICROFLUIDIC R&D



Microfluidic Prototype Breadboard System with Fittings, Valves, Pumps and Other Devices

Sandia National Laboratories is offering to license for commercialization a suite of miniature, high quality, high pressure and reusable connection components that makes microfluidic prototype system development fast and easy. Used for years by researchers at Sandia, available components consist of extremely small one-piece sleeveless fittings, in-line and multi-port selector valves, a precise fluid metering pump, re-usable lab-on-a-chip manifolds, and a microfluidic prototype breadboard platform. Designed and used for rapid prototyping of microfluidic systems, these components precisely and reliably direct fluid flow to active devices for sample processing and analysis.

These components allow researchers to quickly and easily assemble, test and reconfigure capillary-based, chip-based and hybrid microsystems. For several years, Sandia has used these components, along with rapid plastic- and glass-chip fabrication, to create µChemLab™, BioBriefcase™ and related portable chemical and biological detection device prototypes. µChemlab is a miniaturized prototype system using microfabricated substrates that forms the basis for self-contained, hand-held, highly sensitive devices for rapid chemical and biological analysis. Another prototype system, BioBriefcase, is a briefcase-sized broad-spectrum bioagent detector that features dramatically reduced reagent consumption, improved sensitivity and rapid response time. Originally developed for homeland security and defense, similar systems based on these technologies might also be used for water quality analysis, medical and dental diagnostics, etc.

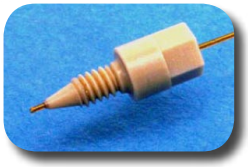
Available to license for commercialization, these connection components are described on the following pages. If your company, university or organization has interest in making, distributing and/or using the microfluidic connections described on the following pages, please contact Sandia National Laboratories.

Sandia National Laboratories contact:

Jim Wilhelm
Licensing Executive
Corporate Business Development & Partnerships
jpwilhe@sandia.gov
925.294.3673

SAND2005-7233 P
November 2005

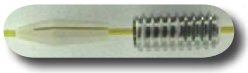
CapTite™ Fittings & Interconnects



One-Piece Fitting

⇨ *High pressure, small, and easy to use (no sleeves)*

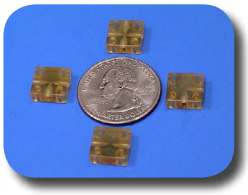
One-piece fittings used to connect capillary tubing and similar devices with all of the interconnects, manifolds, pumps, and valves listed below. Designed and precision manufactured for direct high pressure seals to 1mm or less diameter capillary tubes (360µ capillary tube shown), fiber optic cable, electrodes, etc. These miniature fittings are pressure rated to 5,000psi finger-tight and to 10,000psi tool-tight with no sleeves. Reliably seal hundreds of times. Measuring 3.5mm x 8mm with 2–56 threads, they are easily handled. Can be made of PEEK™, Ultem™, stainless steel, or most other materials, so they can withstand harsh environments and be autoclaved. Patent applied for.



Two-Piece Fitting

⇨ *Ultra high pressure, small, and easy to use (no sleeves)*

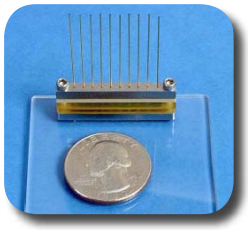
Two-piece fittings connect capillary tubing and similar devices with all of the interconnects, manifolds, pumps, and valves listed below. Designed and precision manufactured for direct ultra high pressure seals of 1mm or less diameter capillary tubes (360µ capillary tube shown), fiber optic cable, electrodes, etc. These miniature fittings are pressure-rated to 40,000psi tool-tight with no sleeves. Reliably seal multiple times. Measuring 1.5mm x 8mm with 2–56 thread series, they are easily handled. Can be made of PEEK™, Ultem™, stainless steel, or other machineable materials, they can withstand high temperatures, including autoclave. U.S. Patent 6,929,313.



Multiport Interconnects (Union, Elbow, Tee & Cross)

⇨ *Compact breadboard-compatible interconnects*

Unions, elbows, tees, and crosses are designed for high pressure one-piece fittings and ultra high pressure two-piece fittings. Measures 10mm x 10mm x 3.5mm with 2–56 thread series with mounting holes for standard microfluidic breadboard platform (see Microfluidic Prototyping Breadboard Platform described below). Precise mating of capillary tubes provides minimal dead volumes. Can be made of PEEK™, Ultem™, stainless steel, or most other materials, so they can withstand harsh environments and be autoclaved. Patent applied for.



Multi-Capillary Interconnect

⇨ *Compact connector for multiple capillary tubes and similar devices*

Compact connector quickly, securely, uniformly, and simultaneously connects and seals multiple devices to manifolds/connector bodies, directly to substrates (such as lab-on-a-chip), or to other capillary bundles, in a predetermined arrangement. Fast, repeatable connections with simple 4-piece assembly. Pressure-rated to 10,000psi. Low fluid dead volume. Size shown: 7mm x 32mm x 10 mm. Materials shown: PEEK™ ferrule plate, Ultem™ manifold, and stainless steel stiffing and backing plates. Patent applied for.

Luer-Lock™ Adapter

⇨ *Directly connects fittings to Luer-Lock™ ports*

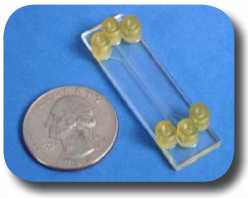
Allows clean, repeatable fluid dispensing and quick connection and removal. Direct connection to capillary isolates microsystems from mechanical forces during syringe-driven fluid transport. Size shown: 10mm x 14mm. Made of PEEK™.

Fitting Installation Tools

⇨ *Tools to tighten fittings*

Several application-specific tools are used to handle and tighten fittings, with capillary tubes inserted, in hard-to-reach places.

ChipTite™ Manifolds



Bonded Port Connector

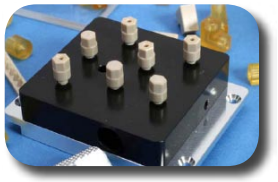
⇨ *High pressure lab-on-a-chip connector*

Low dead-volume port adapter designed for direct bonding to substrates or devices, such as lab-on-a-chip. Compatible with all fittings. Minimum pressure ratings: 5,000psi on glass and 18,000psi on ceramic. Compatible with a variety of bonding techniques. Protrusions provide easy, accurate alignment. Size shown: 5mm x 5mm diameter. Typically made of Ultem™ or PEEK™. Patent applied for.

Edge Compression Manifold

⇨ *Quick capillary connections to peripheral lab-on-a-chip ports*

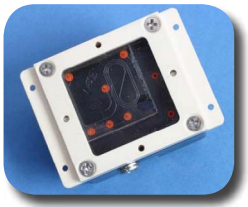
Used for quick and easy lab-on-a-chip connection to devices. Can be used for loading and priming or as a permanent manifold. Captured o-rings seal directly to substrates to enable repeatable low dead-volume seals and remain captured during chip installation and removal. Compatible with all fittings. Scaleable (size shown: 50mm x 15mm x 20mm). Made of most materials (PEEK™ and acrylic shown). U.S. Patent 6,832,787.



Substrate Manifold

⇨ *General lab-on-a-chip interface*

Used to connect and seal various devices (capillaries, fiber optics, wires, etc.) to substrate (such as lab-on-a-chip) ports and channels. Simultaneously attaches to predetermined substrate locations and aligns substrate and manifold ports. Captured o-rings seal directly to substrates to enable repeatable low dead-volume seals and remain captured during chip installation and removal. Eliminates use of pipette tips. Fittings compatible. Scaleable (size shown: 32mm x 32mm x 13 mm high). Can be made of most materials (Delrin™ shown). Patent applied for.

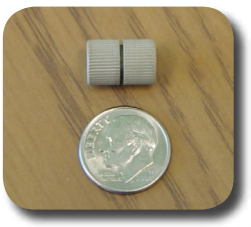


Micromanifold Assembly

⇨ *For simple leak and bubble-free lab-on-a-chip connection*

Easily aligns and connects to chips with complex geometry. Multiple reservoir cartridges provide repeatable, simultaneous, leak-free and bubble-free connections for fast reagent changes or replenishment. Captured o-ring seals. Approximate working pressure: 800psi. Fittings compatible. Size shown: 32mm x 32mm x 22mm. Can be made of most materials (Delrin™ and polyphenylenesulfide shown). Patent applied for.

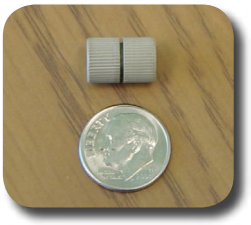
Micro-Fluidic Valves, Pumps & Breadboard



Microvalve

⇨ *Miniature in-line on/off valve*

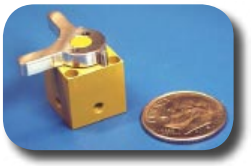
Designed for uniaxial rotary actuation and connection to a variety of microdevices. Low swept and dead volumes. Manually actuated. Uniaxial rotation requires no additional space for manual actuation. Size shown: 11mm x 7mm diameter. Material shown: PEEK™ . U.S. Patent 6,918,573.

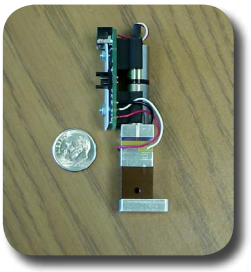


Fluid Injection Microvalve

⇨ *Miniature in-line valve for fluid injection*

In-line manually or electronically actuated valve for injection of predetermined fluid volumes. Enables sub-nanoliter volumetrically tailored and selectable injections. Multi-port configurations (4 ports shown). Size shown: 11mm x 7mm diameter. Material shown: PEEK™ with stainless injection plate. Patent applied for.





Multi-Port Selector Valve

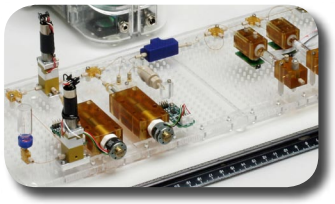
⇨ *Small high pressure valve with low swept volume*

Manually or electronically actuated multi-port high pressure selector valve with swept volume less than 10nL. Maximum pressure rating: 10,000psi. Tested to 200,000 cycles. Size: 12.5mm x 12.5mm x 12.5mm. Materials shown: Torlon™ and Vespel™. Patent applied for.

Syringe Pump

⇨ *Precise fluid metering*

For precise metering of fluids over a wide range of flow rates and pressures. Stepper motor controlled fluid metering. From nanoliter steps to 10mL/min. Bidirectional for easy syringe reloading. Compact size: 9.5mm x 2.5mm x 1.5cm. Materials shown: Ultem™ body, glass syringe, Teflon™ plunger.



Microfluidic Prototyping Breadboard Platform

⇨ *Breadboard platform and hardware for microfluidic systems prototyping*

Standardized breadboard for mounting and positioning components for rapid and robust fabrication of microfluidic systems. Easily reconfigured with a variety of mounting, attachment, and positioning hardware. Enables standardized assemblies. Variable sizes (image shows 6in x 14in). Patent applied for.